MOTOROLA
Americas Parts Division

R1150/R1151

CODE SYNTHESIZER II

OPERATOR'S MANUAL

68P80310B03-B

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SECTION I. R1150

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SECTION II. R1151

SPECIFICATIONS FOR THE CODE SYNTHESIZER II

R1150

Operating Modes:
- •Single Tone
- •Two-tone Sequential
- •5/6 tone
- •Digital Paging (GSC, NEC, POCSAG, SGP)
- •Car Telephone (IMTS, MTS, 2805)
- •Coded Squelch (PL, DPL)
- •DTMF

Frequency Range:
- •Single Tone 0.1Hz to 3275Hz
- •Multi-frequency tone pairs 0.1Hz to 2100Hz each

Frequency Resolution:
0.1Hz

Frequency Accuracy (over temperature):
0.5%

Analog Output:
- •Waveshape: Sinewave
- •Distortion: less than 1% at 1kHz
- •Frequency Response: +0.25dB, -2.0dB (50Hz to 3275Hz)
- •Impedance: 600 ohms balanced
- •Voltage: 0Vrms to 1.5Vrms

Digital Output:
- •Waveshape: Square wave (band limited)
- •Voltage: +/-1.0Vdc
- •Impedance: 100 ohms, maximum

Operating Temperature:
0C to +55C

Storage Temperature:
-40C to +75C

Input Power:
90Vac -135Vac or 200Vac-240Vac, switchable, 50Hz/60Hz

R1151

Performance Specifications cover ALL Digital Paging formats specified in the R1151 manual section, Section II unless otherwise specified. Specifications for all Analog Output formats and Digital Output formats covered in Section I remain the same with the RLN4504 installed.

Digital Output:
- •Waveshape: Square wave (band limited)
- •Voltage: +/-1.0Vdc
- •Impedance: Will drive up to 120 ohm input load at +/-1.0V
- •Timing Stability: +/-100ppm over operating temperature
- •Digital Edge Rise/Fall Time: 35uS, maximum, +1.0V to -1.0V, -1.0V to +1.0V

MODEL NUMBERS AND ACCESSORIES FOR THE R1150 CODE SYNTHESIZER II AND THE R1151 EXPANDED CODE SYNTHESIZER II

Accessories:

58-84066A74	Banana Jack to BNC Female
65-802992	Fuse, 1/4 amp, 250V, slow blow for 110Vac use
65-138973	Fuse, 1/8 amp, 250V, slow blow for 220Vac use
30-80397A62	Power cord with U.S. plug

Model Numbers:

R-1150E	Code Synthesizer II
R-1150E220V	220Vac Code Synthesizer II
R-1151A	Expanded Code Synthesizer II
R-1151A220V	220Vac Expanded Code Synthesizer II
RLN-4504A	R1150 Memory Upgrade Kit

1.0 GETTING ACQUAINTED - A Quick Look

1.1 Introduction

The R1150 Code Synthesizer II is a microcomputer controlled audio synthesizer capable of generating the tone and data formats used for selective signaling over voice grade communications channels. You can select the most common signaling formats with the front panel function selector. Each format is generated according to a default set of frequency and timing parameters stored in the R1150's memory. The user may send a sequence using the default parameters or change the parameters for special purpose signaling requirements. Data generation capabilities are provided in the DPL and Digital Paging functions.

This manual is divided into three sections. Section 1 provides an introduction to the R1150 as well as a power-up functional test. Section 2 describes in detail the use of the keyboard function keys. Section 3 describes how you can generate each signaling format supported by the R1150.

NOTE: In the following pages, the contents of the R1150's display will be shown in double quotation marks:" ". The names of specific keys will be shown capitalized and outlined as such: CLEAR is the clear key.

1.2 Power-Up Functional Test

We recommend that the instructions in this section be followed when you first unpack the R1150 or if you suspect a functional problem with your unit. If your unit passes this basic functional check, make sure you completely understand and follow the directions for the specific signaling format you wish to implement. If your unit still does not perform as expected, contact the appropriate Test Equipment Service Center listed in Section 1.3 for further assistance.

Figures 1.2-1 and 1.2-2 show the arrangement of the front and rear panels, respectively. Before powering up your unit, first check that the voltage selector on the rear panel is set for the correct line voltage. Plug the unit in and set the ON POWER switch to the ON position. The display will read "1150 x.x" in which "x.x" is the version number of the installed firmware. If nothing happens when the unit is turned on, unplug the unit and check the fuse in the rear panel fuse holder (see specifications page for proper fuse sizes and part numbers) . If the fuse is good, contact the Test Equipment Service Center for further assistance.

Five seconds after turning the unit on, the display will show " 0" indicating that the R1150 is ready for use. Verify that all the keyboard keys are operational by performing the following tests.

1) Enter the digits 1 through 8 by pressing each of the corresponding digit keys on the keyboard. The display will read "12345678".

2) Press the CLEAR key to clear the display and verify that the display shows a single zero.

3) Enter the digits 9 and 0 by pressing the corresponding keys. Enter the DTMF digits A, B, C, D, *, # by pressing the corresponding keys. The display will read "09AbCdEF". NOTE: the * and # characters are displayed as "E" and "F".

4) Clear the display with the CLEAR key. Enter the following sequence of keys: 1, 0, 0, ., 5, followed by the STORE key and 0. The display will read "0 100.5".

5) Press the down arrow key eight times. After each press, verify that the LED indicator advances down the column of functions. With the indicator for Digital Paging on, press the INVERT DATA key. The Invert LED will come on and the Normal LED will shut off. Press the up arrow key twice so the Tone Control indicator is lit. Press the SEND key. The message " 12-" will scroll in from the right side of the display. Press the CLEAR key to end the test.

This completes the initial power-up check. If the R1150 did not perform as indicated, consult the appropriate Test Equipment Service Center listed in Section 1.3 for assistance.

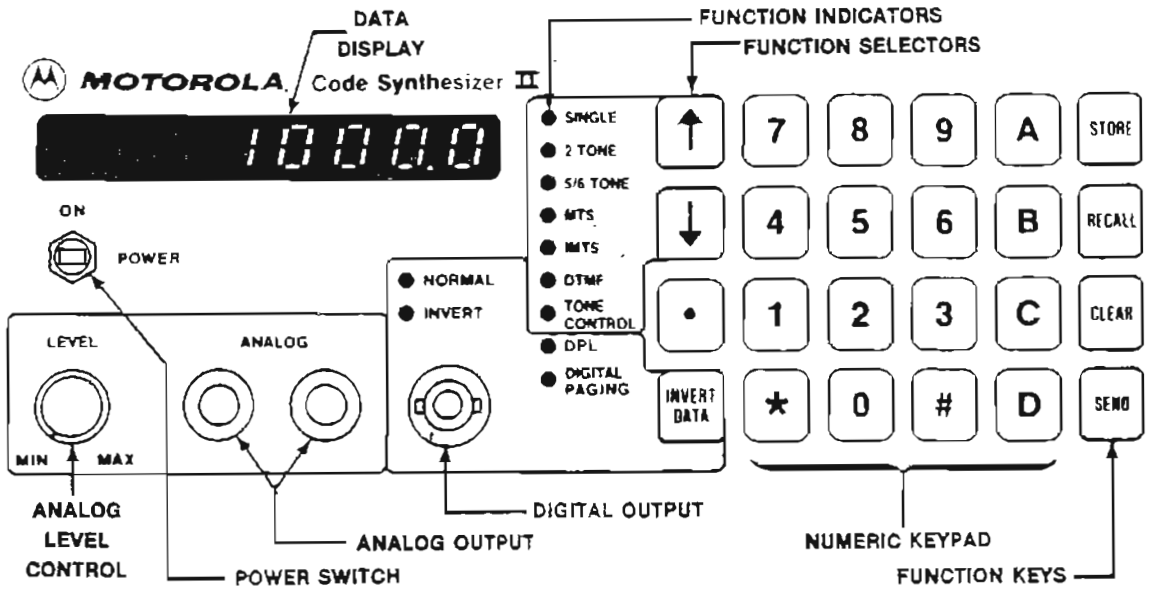
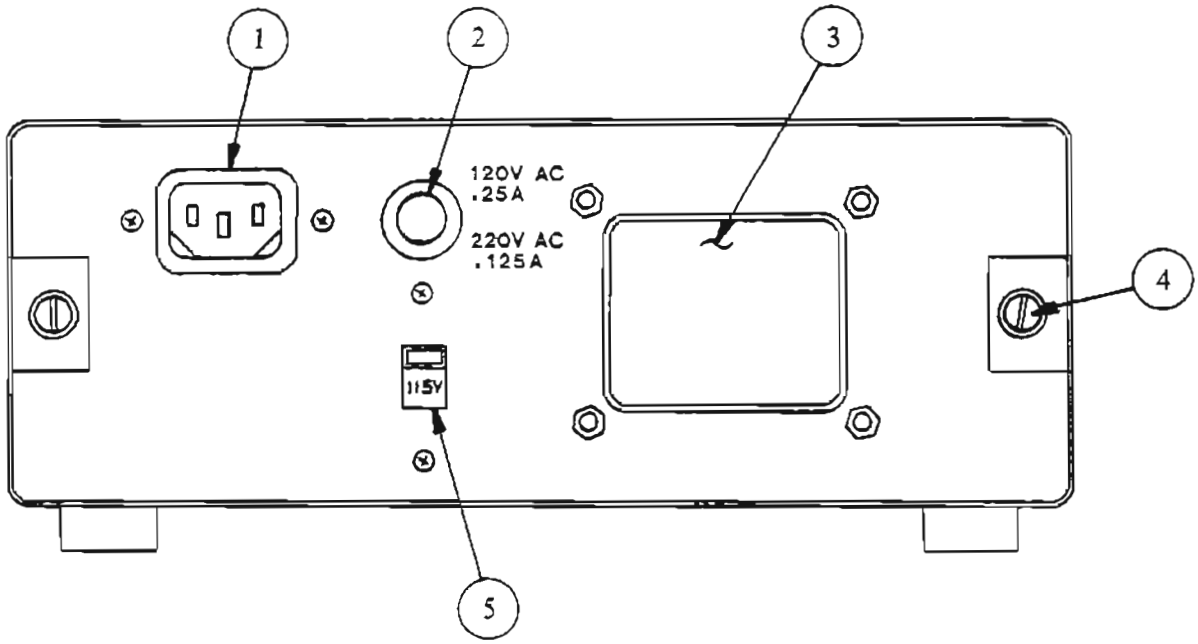


FIGURE 1.2-1. R1150 FRONT PANEL



(1) AC INPUT - three prong input for 120V ac or 220V ac

(2) AC Line Fuse - rated at .25A for 120V ac and .125A for 220V ac (slow blow)

(3) Power Transformer

(4) Turn Lock Fasteners - two of these fasteners secure the housing to the main chassis

(5) Voltage Selector Switch

FIGURE 1.2-2. R1150 REAR PANEL

1.3 Test Equipment Service Centers

We recommend before sending your unit in for repair that you contact the appropriate service center to obtain the correct procedure and information required to reduce repair time.

In the United States, for assistance and repair contact:

Motorola Test Equipment Repair Center
(708) 576-7025
1308 Plum Grove Road
Schaumburg, IL 60173.

Outside of the United States, contact your nearest Motorola representative to obtain the name of the closest Motorola approved service center.

2.0 KEYBOARD BASICS

2.1 Default Frequency and Timing Parameters

Each signaling format the R1150 supports has from one to sixteen parameters associated with it. Parameters are stored in RAM memory bytes called *registers*. Registers are numbered from 0 to 9 and/or letters A, B, C, D, *, #. Registers are referred to as Rx, in which x denotes the particular register number.

NOTE: the characters * and # are displayed as "E" and "F", respectively.

The registers hold frequency and timing information used by the selected function when a sequence is generated. Each time the R1150 is turned on, all registers are programmed with default frequency and timing parameters; the default value are those most often used with each function. Table 2.1-1 is a list of each function and the associated registers as well as the default value of each parameter.

2.2 Displaying Register Parameters - the RECALL Key

To display the register contents for a particular function, first select the appropriate function with the UP or DOWN arrow keys. Using Table 2.1-1, determine the register number you wish to view. Press the RECALL key followed by the desired register number to display the value of the parameter. The display will show the register number in the left most digit, followed by the value stored in that register at the right of the display.

All frequency parameters are displayed in units of hertz (Hz) with a resolution of 0.1Hz. All timing information is displayed in units of milliseconds (mS) with a resolution of 1mS. Therefore, if register 3 (R3) contained a timing parameter of 1 second, pressing the RECALL key followed by the 3 key displays "3 1000".

Example:

Determine what frequency is sent when the Single function is first selected.

Step 1: Select the Single tone function, using the UP and DOWN arrow keys.

Step 2: Table 2.1-1 indicates that 1000.0 Hz is the default frequency for this function and is stored in register 0 (R0). Verify this by pressing the RECALL key followed by the 0 key. The display will read "0 1000.0".

2.3 Modifying Register Information - the STORE key

You can modify any of the parameters listed in Table 2.1-1 with the following procedure.

1) Select the particular function desired with the UP or DOWN arrow keys.

2) Enter the new value of the parameter using the keyboard. If you make a mistake, use the CLEAR key to clear the display and then enter the correct information.

NOTE: The contents of a register can only be modified by the store operation. The CLEAR key ONLY clears the display, NOT the register contents.

3) With the desired parameter on the display, press the STORE key followed by the key corresponding to the desired register. The left

TABLE 2.1-1. R1150 DEFAULT PARAMETERS

Function	Register Description	Register	Default Value
Single	Tone Frequency	R0	1000.0Hz
	Dial Pulse-Break Time	R1	50mS
	Dial Pulse-Make Time	R2	50mS
	Interdigit Time	R3	0
2-Tone	Mode Number	R0	0
	First Tone Frequency	R1	1000.0Hz
	Second Tone Frequency	R2	500Hz
	First Tone On Time	R3	1000mS
	Intertone Gap Time	R4	250mS
	Second Tone On Time	R5	2500mS
	Delay Time Before Repeat	R6	2000mS
	Number of Repeats	R7	1
5/6 Tone	Digit 0 Frequency	R0	600.0Hz
	Digit 1 Frequency	R1	741.0Hz
	Digit 2 Frequency	R2	882.0Hz
	Digit 3 Frequency	R3	1023.0Hz
	Digit 4 Frequency	R4	1164.0Hz
	Digit 5 Frequency	R5	1305.0Hz
	Digit 6 Frequency	R6	1446.0Hz
	Digit 7 Frequency	R7	1587.0Hz
	Digit 8 Frequency	R8	1728.0Hz
	Digit 9 Frequency	R9	1869.0Hz
	Preamble On Time	RA	690mS
	Preamble Tone Frequency	RB	600.0Hz
	Digit Tone-on Time	RC	33mS
	Dual Address Tone Frequency	RD	2010.0Hz
	Repeat Tone Frequency	RE	459.0Hz
	Service Block Code (HSC Only)	RF	1
MTS	Frequency 1	R0	600.0Hz
	Frequency 2	R1	1500.0Hz
	Dial Pulse Width	R2	100mS
	Interdigit Time	R3	500mS
IMTS	Mode Number	R0	1
	Idle Tone Frequency	R1	2000.0Hz
	Seize Tone Frequency	R2	1800.0Hz
	Dial Pulse Break Time	R3	50mS
	Dial Pulse Make Time	R4	50mS
	Interdigit Time	R5	250mS
	Delay Time before ANI	R6	500mS
DTMF	Mode Number	R0	0
	Tone On Time	R1	100mS
	Tone Off Time	R2	100mS
	MF Custom Frequencies	R3-RA	0.0Hz
Tone Control	Guard Tone Frequency	R0	2175.0Hz
	Function Tone Frequency	R1	1950.0Hz
	High Level Guard Time	R2	125mS
	Function Tone Time	R3	40mS
	Aux Tone Frequency	R4	1750.0Hz
	Aux Tone On Time	R5	0mS
DPL	Mode Number	R0	1
Digital Paging	Mode/Paging Format	R0	1
	Page Repeat	R1	0
	Modem Mark Frequency	R2	1200.0Hz
	Modem Space Frequency	R3	2200.0Hz
	Baud Rate	R4	0
	POCSAG Sync Codeword	R5	1
	POCSAG Message Multiplier	R6	1

most digit of the display will now indicate the register to which the information was stored; the right side of the display shows the information you just entered.

The following rules apply to storing data in registers.

1) If an attempt is made to store data in a register that does not exist for the function selected, an error message will be displayed.

2) Frequency information may not exceed 3275Hz while timing information may not exceed 64000, that is 64 seconds.

3) Frequency information may be programmed with a resolution of 0.1 Hz. If a decimal point is not entered it will be assumed to be located to the right of the last digit entered. If a decimal point is entered then only one additional digit will be accepted.

4) If a frequency is stored in a register that is not to hold a frequency in the current function, it will not display a decimal point when it is recalled.

Example

The previous recall operation indicated that the Single function was programmed to generate 1000.0 Hz. However, you desire to generate a 67.0 CTCSS tone using this function. This may be done by pressing the 6 key and the 7 key followed by the **STORE** key and the 0 key. The display will read "0 67.0" and the R1150 will now be generating 67.0 Hz.

2.4 Dialed Digit Outpulsing

From 1 to 8 dialed digits may be outpulsed either in a group or individually for the DTMF, MTS, IMTS, and Single functions.

To outpulse digits individually, clear the display, press the **SEND** key, and wait for a dash "-" to be displayed. Enter the digit to be outpulsed. A dash will again be displayed when the outpulsing of the single digit has been completed. As soon as the dash reappears the R1150 is ready to accept another digit for outpulsing. Both before and after the digit is outpulsed, the function may be outputting the selected format. For example, if you select the Single function, the tone stored in register R0 will be output both before and after the single digit is outpulsed.

To outpulse a group of digits, clear the display and enter the group of digits, the first digit to be outpulsed is entered first. Press the **SEND** key to start the outpulsing. The left most digit in the display will be sent first. The dash will again be displayed when all of the digits in the group have been outpulsed. Once the dash has been displayed you may enter individual digits as before or you may enter another group of digits. After outpulsing a group of digits, if you press the **RECALL** key (DO NOT ENTER A REGISTER NUMBER), the last group of digits outpulsed will appear on the display. The entire group may again be outpulsed by pressing the **SEND** key.

2.5 Error Messages

The error message "Error " indicates that one of the following types of invalid keyboard operations was performed.

1) Attempt to store or recall from a function register that does not exist.

2) Sending a sequence before the capcode or dialed digit information has been entered (for 5/6 tone, IMTS mode 2, DPL and Digital Paging).

3) Storing a number that is larger than that allowed for frequency and timing parameters (see section 2.3) or that is not a legitamate input for the particular function.

If the error message should be displayed press the **CLEAR** key to clear the display and enter the correct information.

3.0 USING THE R1150 FUNCTIONS

The R1150 has two outputs, ANALOG and digital. The analog output is a 600 ohm floating, balanced connection. The output level is adjustable with the front panel control from a few millivolts to 1.5 volts RMS.

NOTE: The analog output should not be connected to a device with an ungrounded chassis such as a transformerless TV.

Connect the analog output (dual banana jacks) to the external modulation input of a signal generator or service monitor. Adjust the generator deviation using either the R1150 level control or the generator external modulation control.

The digital output (BNC) is used for DPL and the Digital Paging functions. It is a bipolar, +/- 1 volt signal, with a 0 volt idle or off state. The output impedance is less than 100 ohms. The deviation of the generator is adjusted using the signal generator's external modulation control. **There is no way for you to adjust the digital output level on the R1150.**

3.1 Single Tone

The Single function is used for generating single tones, e.g. CTCSS tones as well as single tone interrupted signaling. Single tone interrupted digits may be outpulsed in a group or individually (see section 2.4). There are 4 registers associated with the Single function; these are listed below with their default values.

Reg.#	Description	Default Value
0	Tone Frequency	1000.0 Hz
1	Dial Pulse-Break Time	50mS
2	Dial Pulse-Make Time	50mS
3	Interdigit Time	250mS

As soon as the Single function is selected a tone is generated on the frequency stored in register R0. To change the frequency, first clear the display, enter the new tone frequency, and press the **STORE** key followed by the **0** key. The R1150 will now be generating the new frequency being displayed.

3.1.1 2805 Signaling

Mobile telephone signaling in 2805 format may be generated by outpulsing a 2805 Hz tone as described in section 2.4.

3.1.2 HEAR Signaling

HEAR signaling may be generated by outpulsing a 1500 Hz tone as described in section 2.4.

Code	Frequency (Hz)	Code	Frequency (Hz)
XZ	67.0	4Z	136.5
XA	71.9	4A	141.3
XB	77.0	4B	146.2
YZ	82.5	5Z	151.4
YA	85.4	5A	156.7
YB	88.5	5B	162.2
ZZ	91.5	6Z	167.9
ZA	94.8	6A	173.8
ZB	97.4	6B	179.9
1Z	100.0	7Z	186.2
1A	103.5	7A	192.8
1B	107.2	8Z	206.5
2Z	110.9	M1	203.5
2A	114.8	M2	210.7
2B	118.8	M3	218.1
3Z	123.0	M7	250.3
3A	127.3	M4	225.7
3B	131.8	9Z	229.1

TABLE 3.1-1 COMMON PL TONES

3.2 2-Tone

The 2-Tone function is used to generate 2-tone sequential signaling. There are 8 registers associated with the 2-Tone function. These are listed below with their default values.

Reg.#	Description	Default Value
0	Mode Register: 0=normal, 1=reverse	0
1	First tone frequency	1000.0Hz
2	Second tone frequency	500.0Hz
3	First tone on time	1000mS
4	Intertone gap time	250mS
5	Second tone on time	2500mS
6	Delay time before repeat	2000mS
7	Number of 2-tone cycles	1

To send a 2-Tone sequence, store the desired first and second tone frequencies in register R1 and register R2 respectively. The first tone frequency is commonly referred to as Tone A, and the second tone frequency is Tone B. Pressing the **SEND** key will cause the tone sequence to be generated according to the timing parameters stored in registers R3-R5. To generate consecutive sequences of the two tones, store the total number of cycles in register R7 and the delay time between sequences in register R6. Press the **SEND** key to start the cycle.

For a sequence of two tones, the display will show the following sequence.

R1150 Display	R1150 Output
" 1"	First tone
" 1-"	Intertone gap
" 1-2"	Second tone

If you send two cycles of the two tones, the display will show the following sequence.

R1150 Display	R1150 Output
" 1"	First tone
" 1-"	Intertone gap
" 1-2"	Second tone
" 1-2-"	Between cycle gap
" 1"	First tone, 2nd cylce
" 1-"	Intertone gap, 2nd cycle
" 1-2"	Second tone, 2nd cycle

This display sequence repeats for as many cycles stored in register R7.

3.2.1 Reverse 2-Tone

A reverse 2-tone feature is provided and may be selected by storing a 1 in register R0. When in reverse mode the second tone frequency is sent first with the timing parameters assigned to the first tone frequency, followed by the intertone gap, followed by the first tone frequency with the timing parameters of the second tone frequency. The display indicates the reverse 2-tone sequence by displaying a "2-1" sequence according to the sequence stated in Section 3.2.

3.2.2 Quik Call II

Quik Call II sequences are generated by sending a 2 tone burst with a Tone A duration of 1.25 seconds, 0.25 seconds of intertone gap, and 3 seconds of Tone B. Refer to Figure 3.2.2-1 for Quik Call II timing. Both the radio paging codes (Table 3.2-1) and the Quik Call codes (Table 3.6.3-1) are commonly used.

3.3 5/6 Tone

The 5/6 Tone function may be used to generate seven types of formats that are based on the decimal digit type of sequential tone signaling. The seven formats include the standard US 5/6 Tone, the HSC radiopaging format, the European ZVEI, modified ZVEI (ZVEI-2), CCIR, modified CCIR (CCIR-2) and EEA formats. There are 16 registers associated with the 5/6 Tone function. The type of signaling generated depends on the information stored in mode register, RB, according to the following table.

RB Contents	Format
1	US 5/6 Tone
2	HSC Format
3	ZVEI
4	ZVEI-2
5	CCIR
6	CCIR-2
7	EEA

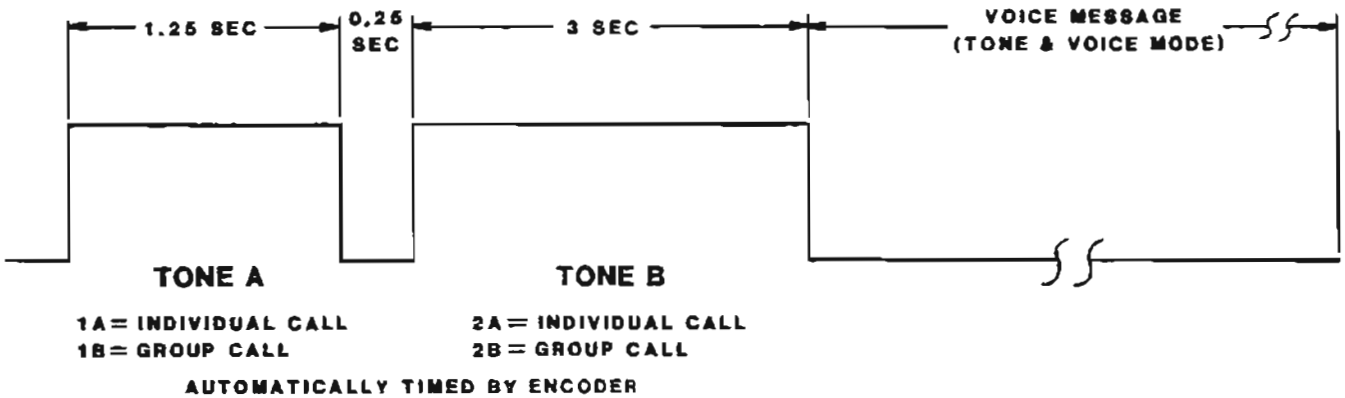


FIGURE 3.2.2-1. QUIK CALL II TIMING

TONE NUMBER	TONE GROUP 1		TONE GROUP 2		TONE GROUP 3		TONE GROUP 4		TONE GROUP 5		TONE GROUP 6	
	FILTER CODE	FREQ. (Hz)	FILTER CODE	FREQ. (Hz)	FILTER CODE	FREQ. (Hz)	FILTER CODE	FREQ (Hz)	FILTER CODE	FREQ. (Hz)	FILTER CODE	FREQ. (Hz)
1	111	349.0	121	600.9	138	288.5	141	339.6	151	584.8	191	1153.4
2	112	368.5	122	634.5	108	296.5	142	358.6	152	617.4	192	1185.2
3	113	389.0	123	669.9	139	304.7	143	378.6	153	651.9	193	1217.8
4	114	410.8	124	707.5	109	313.0	144	399.8	154	688.3	194	1251.4
5	115	433.7	125	746.8	160	953.7	145	422.1	155	726.8	195	1286.8
6	116	457.9	126	788.5	130	979.9	146	445.7	156	767.4	196	1321.2
7	117	483.5	127	832.6	161	1006.9	147	470.5	157	810.2	197	1357.6
8	118	510.5	128	879.0	131	1034.7	148	496.8	158	855.5	198	1395.0
9	119	539.0	129	928.1	162	1063.2	149	524.6	159	903.2	199	1433.4
0	110	330.5	120	569.1	189	1092.4	140	321.7	150	553.9	190	1122.5

TABLE 3.2-1. TWO-TONE PAGING TONES

Timing	A Duration	A Delay	B Duration	B Delay
TONE ONLY	1.4 sec.	0.0 sec.	0.8 sec.	1.3 sec.
TONE & VOICE	1.0 sec.	0.0 sec.	3.0 sec.	3.0 sec.
TONE BATTERY SAVER	2.7 sec.	0.0 sec.	0.8 sec.	1.3 sec.
GROUP CALL	0.0 sec.	0.0 sec.	8.0 sec.	3.0 sec.

TABLE 3.2-2. TWO-TONE TIMING SEQUENCES

TONE	TONE GROUP 7		TONE GROUP 8		TONE GROUP 9	
	CODE	FREQ. Hz	CODE	FREQ. Hz	CODE	FREQ. Hz
1	101	202.7	4A	141.3	1Z	100.0
2	7A	192.8	4Z	136.5	WB	79.7
3	7Z	186.2	3B	131.8	ZA	94.8
4	6B	179.9	3A	127.3	ZZ	91.5
5	6A	173.8	3Z	123.0	YB	88.5
6	6Z	167.9	2B	118.8	YA	85.4
7	5B	162.2	2A	114.8	YZ	82.5
8	5A	156.7	2Z	110.9	XB	77.0
9	5Z	151.4	1B	107.2	XA	71.9
0	4B	146.2	1A	103.5	XZ	67.0

TONE	TONE GROUP 17		TONE GROUP 18		TONE GROUP 9	
	CODE	FREQ. Hz	CODE	FREQ. Hz	CODE	FREQ. Hz
1	101	202.7	4A	141.3	1Z	100.0
2	7A	192.8	4Z	136.5	WB	79.7
3	7Z	186.2	3B	131.8	ZA	94.8
4	WZ	69.3	3A	127.3	ZZ	91.5
5	6A	173.8	3Z	123.0	YB	88.5
6	6Z	167.9	WA	74.4	YA	85.4
7	5B	162.2	2A	114.8	YZ	82.5
8	5A	156.7	2Z	110.9	XB	77.0
9	5Z	151.4	1B	107.2	XA	71.9
0	4B	146.2	1A	103.5	XZ	67.0

TABLE 3.2-3. COMMON SUBAUDIBLE TONES BY TONE GROUP

The generation of all seven formats depends on the frequency and timing information stored in the other 15 registers. When the R1150 detects a change in the contents of RB it reprograms the other 15 registers with the default timing and frequency information most often used for the format selected. Once a new format has been selected, it is still possible to view and/or modify the contents of any register, using the RECALL and STORE keys respectively, to accommodate variations in any of the seven formats. The following is a list of the default register contents for the US 5/6 Tone format.

Reg.#	Description	Default Value
0	Digit 0 Frequency	600.0 Hz
1	Digit 1 Frequency	741.0 Hz
2	Digit 2 Frequency	882.0 Hz
3	Digit 3 Frequency	1023.0 Hz
4	Digit 4 Frequency	1164.0 Hz
5	Digit 5 Frequency	1305.0 Hz
6	Digit 6 Frequency	1446.0 Hz
7	Digit 7 Frequency	1587.0 Hz
8	Digit 8 Frequency	1728.0 Hz
9	Digit 9 Frequency	1869.0 Hz
A	Preamble on Time	690 ms
B	Mode Register: 1=US 5/6 Tone	1
C	Digit Tone on Time	33 ms
D	Dual Address Tone Frequency	2010 Hz
*	(E) Repeat Tone Frequency	459.0 Hz
#	(F)Service Block Code (HSC Only)	1

For decimal digit type of signaling, each digit in the capcode (or decoder's address) represents a specific tone frequency. In the R-1150, registers R0 through R9 contain the decimal digit's frequency. Therefore, the tone frequencies sent are the ones stored in the registers corresponding to the cap-code. However, if the capcode contains 2 identical digits in a row, the repeat tone frequency stored in register R*, is sent in place of the second identical digit frequency. Registers RA through RD, and R# store additional information about the format selected. Not all 6 registers are necessarily used for every available format.

3.3.1 US 5/6 TONE (Mode 1)

To signal a US 5/6 Tone pager select the 5/6 TONE function, store a 1 in mode register RB, enter the capcode and press the SEND key. If the pager uses a preamble then 6 digits must be entered, otherwise only 5 digits are entered. When 6 digits are entered, the first digit is the preamble digit. To signal the dual address for the pager, enter a decimal point after the capcode. Pressing the SEND key with a decimal point at the end of the capcode causes the pager's second address to be sent. It is possible to enter the pager's first address, i.e. 5 of 6 digits without a decimal point, and send that address as many times as the SEND key is pressed. Pressing the decimal point . key switches to the pager's second address. The second address will be sent as many times as the SEND key is pressed.

3.3.2 HSC Radiopaging Format

The HSC radiopaging format operates much the same a the US 5/6 Tone format in that the same frequency and timing parameters are used. However, 2 control digits follow the 5 digit address and are used to specify which one of 4 types of page is to be generated.

To select the HSC radiopaging format, select the 5/6 TONE function with the up/down arrow keys and store a 2 in mode register RB. Determine the service block code for the paging system and store this code in register R#. Enter the pager's 5 digit address followed by the # key. Remember, the # key is displayed as an "F". Enter a mode control digit for the type of test page desired. There should now be 7 digits in the display. The following table describes the meaning of the 4 mode control digits.

Mode Control Digit	Type of Page
1	Tone Only page
2	Tone and Numeric data Message Page, the message "12345678" is sent to the pager.
3	Tone and Voice page, the pager's speaker is unmuted.
4	Voice Reset, the pager's speaker is muted.

3.3.3 ZVEI, ZVEI-2, CCIR, CCIR-2, EEA

The five European decimal digit formats (Select-5) may be generated by first storing the proper format digit in register RB where 3=ZVEI, 4=ZVEI-2, 5=CCIR, 6=CCIR-2, 7=EEA. If it is necessary to make changes to the default registers values for frequency and timing, make these changes **ONLY** after first selecting the format by storing the desired mode of operation in register RB. Table3.3.3-1 lists the default register values for Select-5.

For Select-5 signaling an address may consist of 1 to 8 digits where the valid digits are 0-9 and "D". To encode one of the Select-5 formats first enter the address digits and then press the **SEND** key.

The first digit in the address is always sent for the amount of time stored in register RA while all other address digits are sent for the amount of time stored in register RC. Therefore, it is possible to extend the first tone time by reprogramming RA.

Register RD contains the Group-Call Tone frequency. To signal all addresses from 25000 to 25999, for example, simply enter "25DDD". To encode an ALL-CALL, enter "DDDDD". When two digits in a row are the same value, the repeat tone frequency stored in register R* is inserted in place of the second digit tone. Therefore, in the above ALL-CALL example, entering "DDDDD" would actually cause the R1150 to generate the tone sequence corresponding to the registers "D*D*D". When ZVEI is selected the user can store 970 Hz in register RE for a system operating on split channels.

3.4. MTS

The MTS function is used to generate Mobile Tepephone Service (MTS) 600/1500 Hz signaling at 10 pps. See Figure 3.4-1. However, in this function the R1150 is not limited to generating only the standard frequencies and timing associated with MTS. The user may change the two frequencies used as well as the outpulsing rate. MTS digits may be outpulsed in a group or individually (see section 2.4). The following is a list of the four register associated with MTS signaling as well as the default value in each register.

Reg.#	Description	Default Value
0	Frequency 1	600 Hz
1	Frequency 2	1500 Hz
2	Dial Pulse Width	(10pps) 100mS
3	Interdigit Time	500mS

In the MTS function, pressing the **SEND** key causes a clearing pulse to be generated before the digits in the display are outpulsed. The clearing pulse consists of 710 mS of frequency 1 followed by 710 mS of frequency 2. Each digit is separated by the interdigit space set by the value stored in register R3. Pressing the

REGISTER	ZVEI	ZVEI-2	CCIR	CCIR-2	EEA	UNITS
0	2400.0	2200.0	1981.0	1981.0	1981.0	Hz
1	1060.0	970.0	1124.0	1124.0	1124.0	Hz
2	1160.0	1060.0	1197.0	1197.0	1197.0	Hz
3	1270.0	1160.0	1275.0	1275.0	1275.0	Hz
4	1400.0	1270.0	1358.0	1358.0	1358.0	Hz
5	1530.0	1400.0	1446.0	1446.0	1446.0	Hz
6	1670.0	1530.0	1540.0	1540.0	1540.0	Hz
7	1830.0	1670.0	1640.0	1640.0	1640.0	Hz
8	2000.0	1830.0	1747.0	1747.0	1747.0	Hz
9	2200.0	2000.0	1860.0	1860.0	1860.0	Hz
A	70	70	100	70	40	ms
B	3	4	5	6	7	Format
C	70	70	100	70	40	ms
D	2800.0	2200.0	2400.0	1981.0	1055.0	Hz
* (E)	2600.0	2400.0	2110.0	2110.0	2110.0	Hz
# (F)	0	0	0	0	0	-

TABLE 3.3.3-1. REGISTER VALUES FOR SELECT-5 SIGNALLING

CLEAR key causes a reset pulse to be generated followed by the removal of tone after 500 mS have elapsed.

3.5 IMTS

The IMTS function is used to generate IMTS base-to-mobile, mobile-to-base, and general purpose FSK signaling. The type of signaling generated depends on the information stored in the seven registers associated with the IMTS function. The following is a list of the default values stored in the seven registers.

Reg.#	Description	Default Value
0	Mode Number	1
1	Idle Tone Frequency	2000 Hz
2	Seize Tone Frequency	1800 Hz
3	Dial Pulse Break Time	50 mS
4	Dial Pulse Make Time	50 mS
5	Interdigit Time	250 mS
6	Delay Time before ANI	500 mS

The number stored in mode register R0 determines which type of signaling will be generated. For IMTS base-to-mobile signaling a 1 must be stored in the mode register. Registers R2 - R5 set the frequency and timing of the digits to be outpulsed. You can change these parameters to generate custom FSK type signaling. For IMTS mobile-to-base signaling a 2 must be stored in the mode register. In this mode you can either originate a call to an IMTS terminal or simulate a mobile's response to a call from an IMTS terminal. Registers R2-R5 are not used in IMTS mode 2.

Since the R1150 does not decode signaling from tl terminal is ready to accept the mobile's ANI digits terminal is ready, the sending of ANI is delayed by the amount of time stored in register R6.

Frequency (Hz)	Function
2000	Idle Tone
1800	Seize Tone
1336	Disconnect Tone
1633	Connect Tone
2150	Guard Tone

TABLE 3.5-1. IMTS FREQUENCIES

3.5.1 Base to Mobile Signaling (Mode 1)

In IMTS mode 1 the R1150 will initially generate the idle tone when the function is selected. See Figure 3.5-1. To signal an IMTS mobile, enter the mobile's ANI digits (from 1 to 8 digits) and press the SEND key. The ANI digits are outpulsed according to the timing parameters stored in registers R3-R5. After all digits are outpulsed a dash will be displayed. You may then do one of the following.

1) Enter additional digits to be outpulsed, one at a time. Enter zeros to simulate ringing to the mobile.

2)Press the RECALL key to return to sending idle tone and recall the last ANI sent.

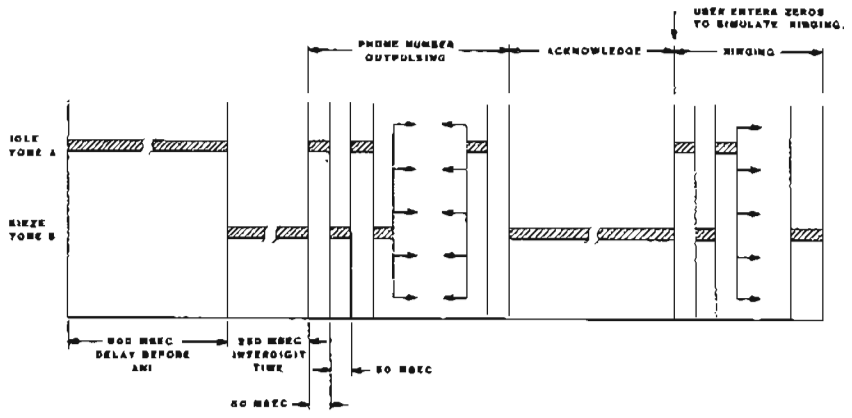


FIGURE 3.5-1. IMTS OUTPULSING, BASE TO MOBILE (MODE 1)

3) Press the CLEAR key to return to sending idle tone and clear the display.

3.5.2 Mobile to Base Signaling (Mode 2)

IMTS mode 2 is used for testing the operation of IMTS central office terminal equipment. In this mode the R1150 may be used to simulate a call from an IMTS mobile or to simulate the mobile's response to a terminal originated call. In IMTS mode 2, three of the keyboard keys take on a special meaning as described below.

Keyboard Digit	New Function
*	Send Acknowledge Tone
#	Send Answer Tone
D	Send Disconnect Tone

3.5.2.1 Mobile Originates the Call

To simulate a mobile originated call to an IMTS terminal, first makes sure that a 2 is stored in register R0 in the IMTS function. Enter the mobile unit's ANI digits (from 1 to 8 digits). While the ANI digits are displayed press the SEND key. The R1150 generates a connect sequence, delays for the amount of time stored in register R6, and sends the ANI displayed at 20 pps with parity.

When all of the ANI digits have been outpulsed, a dash is displayed. At this time you may simulate IMTS mobile dial pulsing by entering each digit, one at a time. Each time a digit is entered it will be outpulsed and a dash is displayed to indicate that the R1150 is ready to accept the next digit. While the dash is displayed, you may press the RECALL key to recall the last ANI sent or you may press the D key to send mobile disconnect signaling. After the disconnect tones are sent the display will show the last ANI sent.

3.5.2.2 Terminal Originates the Call

To simulate a mobile's response to an IMTS call, first clear the display. As soon as the IMTS terminal completes the base to mobile signaling press the * key to send the mobile acknowledgement tone. To simulate mobile answer press the # key. As before, you can send a disconnect by pressing the D key.

3.6 DTMF

The DTMF function generates any of the standard tone pairs associated with the sixteen DTMF digits; you may select this mode of operation by storing a zero in mode register R0. The function also generates user defined multi-frequency (MF) tone pairs; you may select this mode of operation by storing a 1 in mode register R0. The DTMF function has eleven associated registers. The first three registers are preprogrammed with default parameters upon power up as shown in the table below. Registers R3 - RA are used only in operational mode one. Upon power up, these registers contain zeros and you must program them with row and column frequency information as stated in section 3.6.2.

Reg.#	Description	Default Value
0	Mode Number	0
1	Tone On Time	100 mS
2	Tone Off Time	100 mS

The DTMF/MF digits may be outpulsed as a group or individually; see section 2.4 for outpulsing directions. Up to eight digits may be outpulsed automatically, or a sequence of any length may be entered and outpulsed one digit at a time. The rate at which the digits are sent depends on the information stored in registers R1 and R2. Each time a digit is outpulsed the tone pair corresponding to the digit entered is generated for the amount of time specified in register R1 followed by a gap of no tone for the amount of time specified in register R2.

3.6.1 Standard DTMF Signaling (Mode 0)

To select the standard DTMF tone pair frequencies, select DTMF mode 0 by storing a zero in register R0. Registers R3 through RA are not used in mode 0; therefore, the frequency information stored in these registers has no effect on the tone pair frequencies for standard DTMF generation. Table 3.6.1-1 lists the standard tone pairs for each digit. For example, digit 6 has a combined tone pair frequency of 770Hz and 1477Hz.

	1209 Hz	1336 Hz	1477 Hz	1633 Hz
852 Hz	7	8	9	A
770 Hz	4	5	6	B
697 Hz	1	2	3	C
941 Hz	*	0	#	D

TABLE 3.6.1-1: STANDARD DTMF TONE FREQUENCIES

3.6.2 Custom MF Signaling (Mode 1)

To generate custom MF tone pairs first select DTMF mode 1 by storing a one in register R0. Program the desired row frequencies in registers R3 - R6 and the column frequencies in registers R7 - RA. Table 3.6.2-1 shows the relationship between the keyboard digits and the custom row and column frequency registers.

	R7	R8	R9	RA
R3	7	8	9	A
R4	4	5	6	B
R5	1	2	3	C
R6	*	0	#	D

TABLE 3.6.2-1: FREQUENCY REGISTER AND ASSOCIATED CUSTOM MF DIGITS

The frequencies generated for a particular digit correspond to the frequencies in the respective row and column registers. For example, the 5 digit would have the row frequency stored in register R4 and the column frequency stored in register R8. The highest frequency that can be generated is 2100.0 Hz.

EXAMPLE:
Generate (2+2) signaling consisting of a 1500/800 Hz tone pair for one second followed by a 900/750 Hz tone pair for one second.

1) Select two digits to be used for the first and second tone pairs. In this example, digit 1 will be programmed for the first tone pair and digit 5 will be programmed for the second tone pair.

2) Program the frequencies for digit 1 by storing 1500.0 in register R5 (**1 5 0 0 STORE 5**) and 800.0 in register R7 (**8 0 0 STORE 7**).

3) Program the frequencies for digit 5 by storing 900.0 in register R4 (**9 0 0 STORE 4**) and 750.0 in register R8 (**7 5 0 STORE 8**).

4) We choose the tone on time to be one second, and the tone off time or gap time to be zero seconds. Program the tone on time by storing 1000 in register R1; program the tone off time by storing a 0 in register R2.

5) Store a 1 in register R0 for mode 1 operation. Generate the tone sequence by pressing the **1**, **5**, and **SEND** keys. To send the same tone sequence again, press the **RECALL** and **SEND** keys.

3.6.3 Quik Call

Generate Quik Call tone pairs using the 2+2 procedure in paragraph 3.6.2 above using the tone pairs shown in Table 3.6.3-1. Use a tone duration of 1 second with no intertone gap time.

3.6.4 SEL-CAL

SEL-CAL signaling is generated using the frequencies in Table 3.6.4-1.

Channel	TU-202 Tone Designation	P-7810 Tone Designation	Freq. Hz
A	A	BZ	312.6
B	B	CZ	346.7
C	C	DZ	384.6
D	D	EZ	426.6
E	E	FZ	473.2
F	F	GZ	524.8
G	G	HZ	582.1
H	H	JZ	645.7
J	J	KZ	716.1
K	K	LZ	794.3
L	L	MZ	881.0
M	M	NZ	977.2

TABLE 3.6.4-1: TONE DESIGNATIONS

3.7 Tone Control

The Tone Control function is capable of generating tone sequences used in the tone remote control of base station equipment. The preprogrammed Tone Control sequence consists of a burst of 2157Hz high level guard tone (at 0 dBr) followed by a function tone and/or a low level guard tone (transmit hold tone at -20 dBr). See Figure 3.7-1. The low level guard

Code Letter	Freq. (CPS)	Code Letter	Freq. (CPS)	Code Letter	Freq. (CPS)
CZ	346.7	CB	371.5	CA	358.9
DZ	384.6	DB	412.1	DA	398.1
EZ	426.6	EB	457.1	EA	441.6
FZ	473.2	FB	507.0	FA	489.8
GZ	524.8	GB	562.3	GA	543.3
HZ	582.1	HB	623.7	HA	602.6
JZ	645.7	JB	691.8	JA	668.3
KZ	716.1	KB	767.4	KA	741.3
LZ	794.3	LB	851.1	LA	822.2
MZ	881.0	MB	944.1	MA	912.0
NZ	977.2	NB	1047.1	NA	1011.6
PZ	1084.0	PB	1161.4	PA	1122.1

TABLE 3.6.3-1.
QUIK CALL CODE FREQUENCIES

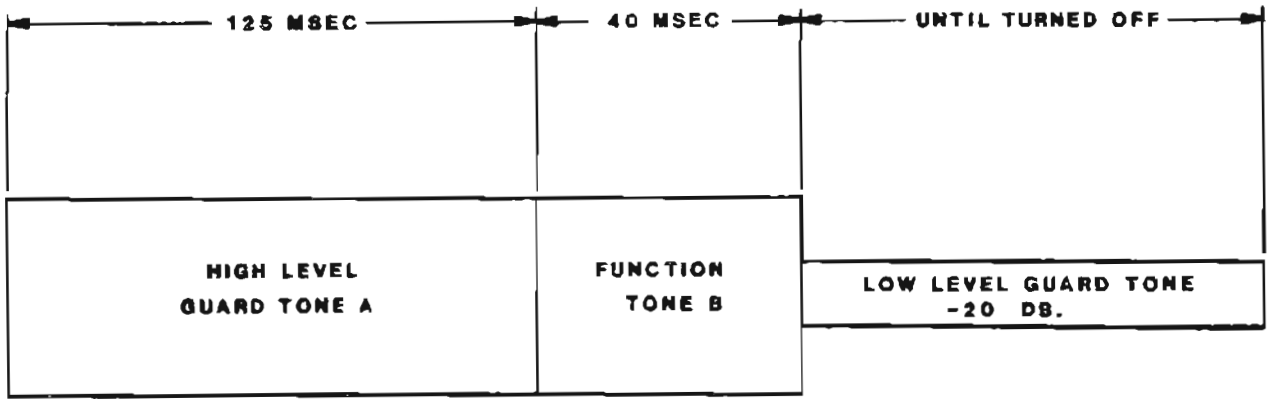


FIGURE 3.7-1. TONE REMOTE CONTROL OUTPUT

tone is continuously sent until the CLEAR key is pressed. A user defined auxiliary burst tone may be sent (at 0 dBr) between the high level guard tone and function tone bursts. To activate this feature simply program the burst time register, R5. There are six registers associated with the Tone Control function; these are listed below with their default values.

Reg.#	Description	Default Value
0	Guard Tone Frequency	2175 Hz
1	Function Tone Frequency	1950 Hz
2	High Level Guard Tone Burst Time	125 mS
3	Function Tone Burst Time	40 mS
4	Auxiliary Tone Frequency	1750 Hz
5	Auxiliary Tone Burst Time	0 mS

To start the tone control sequence press the SEND key. If register R6 is programmed for 0 mS of Auxiliary Tone then the display will read " 1" while the high level guard tone is being generated followed by " 12" while the function tone is being generated followed by " 12-" while the low level guard tone is generated. See Figure 3.7-2. Low level guard tone will be sent until the CLEAR key is pressed. If the programmed value of register R5 is greater than zero, then a "d" will be displayed between the "1" and the "2". Therefore, while low level guard tone is being sent the display will read " 1d2-".

Frequency (Hz)	Function
2175	Guard Tone
2050	"Private Line" Disabled
1950	Transmit F1
1850	Transmit F2
1750	R2 Mute or Receive F1
1650	R2 Unmute or Receive F2
1550	"Max" Squelch or Repeater "Off" or "PL" On
1450	"Min" Squelch or Repeater "On" or "PL" Off
1350	"Wild Card" I On
1250	"Wild Card" I Off
1150	"Wild Card II" On
1050	"Wild Card II" Off

TABLE 3.7-1. TONE REMOTE CONTROL STANDARD FUNCTION TONE FREQUENCIES

3.8 Digital Private Line (DPL) Mode 1,2

Both DPL modes 1 and 2 are associated with testing DPL systems. Mode 1 allows the user to generate the acutal 23 bit DPL data by simply entering the three digit octal DPL code. The data may be sent noninverted (normal) or inverted by using the Invert key. Mode 2 generates a test signal you may use to set your signal generator's FM deviation.

3.8.1 134 Hz Square Wave Generation (Mode 2)

The R1150's digital output may be connected to an FM signal generator or directly connected to the digital input of the DPL board under test. If a signal generator is used, you must use mode 2 to first set the proper FM deviation. If you a connecting the digital output directly to the digital input of the DPL board, skip to section 3.8.2.

NOTE: The signal generator must employ direct FM, NOT phase modulation. In addition, the R1150 data output must either be DC coupled to the modulator or coupled through a large capacitor to insure proper modulation by the NRZ data which contains frequency components near DC.

Complete the following steps to set the signal generator deviation.

1) Select the DPL function with the up/down arrows keys. Store a 2 in register R0.

2) Press the SEND key to generate the 134 Hz test signal.

3) Connect the R1150 digital output to the signal generator's external modulation input; set the FM deviation from +/-0.5kHz to +/-1.0kHz for DPL generation.

NOTE: Depending on the format you are using, normally positive FM deviation is equivalent to positive modulation voltage. Some signal generators have an inverted external modualtion input such that a positive voltage results in negative deviation. If you have such a generator, the INVERT key will make positive modulation voltage result in positive FM deviation by inverting the logic levels.

NOTE: DPL Mode 2 can also be used to set the signal generator deviation before sending digital pages with the Digital Paging function. For digital pages, adjust the FM deviation to +/- 4.5kHz or the deviation recommend by your service guide.

4) Press the CLEAR key to halt generation of the test signal.

NOTE: With the exception of the CLEAR key, the keyboard will be locked while the R1150 is generating a continuous 134Hz test signal. To halt data generation and unlock the keyboard, press the CLEAR key.

3.8.2 DPL Generation (Mode 1)

With the following steps you may generate DPL data, that is a continuous sequence of twenty-three bit codeword(s).

1) Select the DPL function with the up/down arrows keys. Store a 1 in register R0.

2) Enter the three digit octal DPL code number.

3) Press the SEND key to send the data. The data will be sent as shown in Figure 3.8-1. The INVERT key may be used to control the polarity of the data sent. If you get an error message, then either a digit in the DPL code you entered was larger than seven (7) or you entered more or less digits than are in a three digit code number. Valid DPL codes are listed in Table 3.8-1

NOTE: Depending on the format you are using, normally positive FM deviation is equivalent to positive modulation voltage. Some signal generators have an inverted external modualtion input such that a positive voltage results in negative deviation. If you have such a generator, the INVERT key will make positive modulation voltage result in positive FM deviation by inverting the logic levels.

4) To halt data generation, press the CLEAR key. The R1150 will send a 250 mS burst of 134 Hz turn off code and then halt data generation.

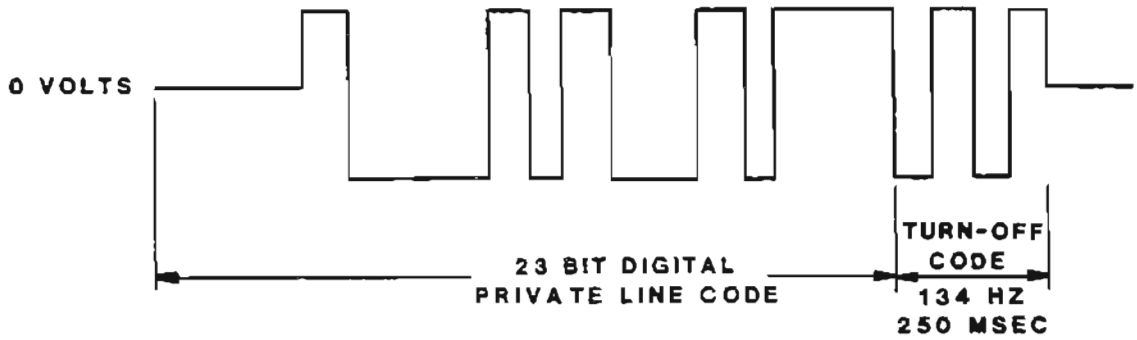


FIGURE 3.8-1. DPL OUTPUT

023	071	134	223	306	411	503	631	734
025	072	143	226	311	412	506	632	743
026	073	152	243	315	413	516	654	754
031	074	155	244	331	423	532	662	
032	114	156	245	343	431	546	664	
043	115	162	251	346	432	565	703	
047	116	165	261	351	445	606	712	
051	125	172	263	364	464	612	723	
054	131	174	265	365	465	624	731	
065	132	205	271	371	466	627	732	

TABLE 3.8-1: VALID DPL CODES

3.9 DIGITAL PAGING

NOTE: The signal generator must employ direct FM, NOT phase modulation. In addition, the R1150 data output must either be DC coupled to the modulator or couplet through a large capacitor to insure proper modulation by the NRZ data which contains frequency components near DC.

NOTE: With the exception of the CLEAR key, the keyboard will be locked while the R1150 is generating continuous data sequences. To halt data generation and unlock the keyboard, press the CLEAR key.

NOTE: DPL Mode 2 can be used to set the signal generator deviation before sending digital pages with the Digital Paging function. For digital pages, adjust the FM deviation to +/- 4.5kHz or the deviation recommend by your pager service guide.

NOTE: For most digital paging formats, a logical 1 corresponds to positive deviation from the RF carrier, and a logical 0 corresponds to negative deviation from the carrier. Normally, inputting +1.0v dc into the modulation input of an RF generator results in positive deviation, and inputting a -1.0v dc results in negative deviation. However, some generators have an inverted modulation input port. In this case, the R1150 INVERT key should be pressed to result in FM deviation of the correct polarity.

The R1150 supports the digital paging formats listed in Table 3.9-1. You may select your desired format by storing the appropriate mode number in register R0.

MODE #	Digital Paging Format
1	Motorola Golay Sequential Code (GSC)
2	NEC (Type D3) - NOT TONE ONLY without display
3	POCSAG numeric
4	POCSAG alpha-numeric
5	Simple Golay Paging (SGP)

TABLE 3.9-1: R1150 DIGITAL PAGING FORMATS

The following is a list of the registers used in the Digital Paging function and their default values.

Reg.#	Description	Default Value
0	Mode Register	1
1	Repeat Register 0=No repeat, 1=Continuous repeat	0
2	Modem Mark Frequency	1200Hz
3	Modem Space Frequency	2200Hz
4	Baud Rate 0=512 baud, 1=1200 baud, 2=2400 baud	0
5	POCSAG Sync Codeword 0,1=Sync 1, 2=Sync 2, 3=Sync 3, 4=Sync 4	1
6	POCSAG Message Multiplier	1

3.9.1 Motorola GSC (MODE 1)

The following procedure is used to signal Motorola digital pagers using GSC format. These pagers include models BPR-2000 and OPTRX. For this format each pager is assigned a 6 digit address or capcode (the OPTRX may have two capcodes). For each capcode the pager can be alerted in up to four different ways, corresponding to the four functional addresses. The function is generally indicated by a seventh digit called the Pager Function Code. Table 3.9.1-1 shows the Functional Address/Pager Function Code/Function relationship. For data pages, the R1150 is capable of sending a display message in either numeric format for BPR2000 pager or alphanumeric format for OPTRX pagers.

1) Use Mode 2 of the DPL function to set the proper FM deviation of your generator, see Section 3.8.1.

NOTE: For most digital paging formats, a logical 1 corresponds to positive deviation from the RF carrier, and a logical 0 corresponds to negative deviation from the carrier. Normally, inputting +1.0v dc into the modulation input of an RF generator results in positive deviation, and inputting a -1.0v dc results in negative deviation. However, some generators have an inverted modulation input port. In this

case, the R1150 INVERT key should be pressed to result in FM deviation of the correct polarity.

2) Select the Digital Paging function with the up/down arrow keys.

3) Select the Motorola GSC format by storing a 1 in register R0.

4) Enter the pager's six digit cap code.

5) Enter the desired pager function digit. See Table 3.9.1-1.

6) For numeric type pagers, enter a "0" ; for alphanumeric pagers enter a "1". There should now be eight digits in the display.

7) Press the SEND key each time you want to send a page. NOTE: Storing a 1 in repeat register R1 sends the page continuously until the CANCEL key is pressed.

The numeric test message is "123456789-0". The alphanumeric message is:

Line 1 "MOTOROLA"
Line 2 "R1150 - GSC"
Line 3 "PAGING TEST".

NOTE: R1150 firmware version 1.1 and higher will send a Motorola binary page for "TEC" and "BHC" series pagers in Digital Paging mode 1. To send a page, enter a 6 digit cap code and press SEND. With a 6 digit cap code, the encoder assumes the use of a binary paging format.

	Functions		
Functional Addresses	Tone & Voice	Tone & Display	Tone Alert
1	1	5	9
2	2	6	0
3	N/A	7	3
4	N/A	8	4
	Function Digits		

TABLE 3.9.1-1 GSC PAGER FUNCTION CODES

3.9.2 NEC Display (MODE 2)

The following procedure is used to signal an NEC display pager.

1) Use Mode 2 of the DPL function to set the proper FM deviation of your generator, see Section 3.8.1.

NOTE: For most digital paging formats, a logical 1 corresponds to positive deviation from the RF carrier, and a logical 0 corresponds to negative deviation from the carrier. Normally, inputting +1.0v dc into the modulation input of an RF generator results in positive deviation, and inputting a -1.0v dc results in negative deviation. However, some generators have an inverted modulation input port. In this case, the R1150 INVERT key should be pressed to result in FM deviation of the correct polarity.

2) Select the Digital Paging function with the up/down arrow keys.

3) Select the NEC signaling format by storing a 2 in register R0.

4) Enter a 0 followed by the pager's six digit cap code.

5) Enter the one digit synchronization code (1, 2, 3, or 4). This code is pager dependent; however, most systems use sync code 1. There should now be a total of eight digits in the display.

6) Press the SEND key to start the page. The display message is "123456789-".

3.9.3 Numeric POCSAG (MODE 3) and Alphanumeric POCSAG (MODE 4)

The R1150 POCSAG routines send POCSAG pagers a fixed message in the same way that the GSC and NEC routines send fixed messages. However, in POCSAG you may vary both the numeric and alphanumeric message length by changing the message multiplier stored in register R6. The base numeric message is five numbers long; the maximum allowed message multiplier is four. Therefore, you can send numeric messages that are five, ten, fifteen or

twenty numbers long. Table 3.9.3-1 shows the numeric message for each multiplier.

Multiplier (R6)	Numeric Message
1	12345
2	1234567890
3	123456789012345
4	12345678901234567890

TABLE 3.9.3-1: POCSAG NUMERIC MESSAGES

The base alphanumeric message is twenty characters long; the maximum allowed message multiplier is seven. Therefore, you can send alphanumeric messages that are twenty, forty, sixty, eighty, one hundred, one hundred twenty, or one hundred forty characters long. The alphanumeric message for a message multiplier of one is :

MOTOROLA R1150 PAGE1

The alphanumeric message for a message multiplier greater than one is :

MOTOROLA R1150 PAGE1
MOTOROLA R1150 PAGE2
.
.
.
MOTOROLA R1150 PAGEx

where "x" is the multiplier.

The following procedure is used to signal a numeric or alphanumeric POCSAG pager.

1) Use Mode 2 of the DPL function to set the proper FM deviation of your generator, see Section 3.8.1.

NOTE: For most digital paging formats, a logical 1 corresponds to positive deviation from the RF carrier, and a logical 0 corresponds to negative deviation from the carrier. Normally, inputting +1.0v dc into the modulation input of an RF generator results in positive deviation, and inputting a -1.0v dc results in negative deviation. However, some generators have an inverted modulation input port. In this case, the R1150 INVERT key should be pressed to result in FM deviation of the correct polarity.

2) Select the Digital Paging function with the up/down arrow keys.

3) Select either the numeric POCSAG or the alphanumeric POCSAG mode. Store a 3 in register R0 to select numeric POCSAG; store a 4 in register R0 to select alphanumeric POCSAG .

4) If you want continuous POCSAG pages sent, store a 1 in register R1. If you want to send just one POCSAG page, store a 0 in register R1.

5) Enter the sync code word number in register R5. Note that the default sync code word 1 is adequate for standard POCSAG.

6) Enter the message multiplier in register R6.

7) Enter the 7 digit pager address.

8) Enter the pager function code, i.e. 1, 2, 3, or 4. Refer to pager operator's manual for definition of the function codes. There should now be 8 digits in the display.

9) Press the **SEND** key to send the page as many times as you want. Note that if a 1 is stored in register R1, the POCSAG sequence will be repeated continuously until you press the **CLEAR** key.

3.9.3 Simple Golay Paging (MODE 5)

The following procedure is used to signal Motorola digital pagers using the SGP format. For this format, each pager is assigned a System number and either a private address or an individual group address. For address limits consult your operators manual or service manual.

1) Use Mode 2 of the DPL function to set the proper FM deviation of your generator according to your pager service manual requirements, see Section 3.8.1.

NOTE: For most digital paging formats, a logical 1 corresponds to positive deviation from the RF carrier, and a logical 0 corresponds to negative

deviation from the carrier. Normally, inputting +1.0v dc into the modulation input of an RF generator results in positive deviation, and inputting a -1.0v dc results in negative deviation. However, some generators have an inverted modulation input port. In this case, the R1150 INVERT key should be pressed to result in FM deviation of the correct polarity.

2) Select the Digital Paging function with the up/down arrow keys.

3) Select the SGP format by storing a 5 in register R0.

4) Enter the system number. Consult your pager Radio Service Software manual or your pager service manual for instruction on how to obtain this number. For example, if our pager system number is 2, after you press the 2 key the R1150 display will show " 2".

5) Press the * key. This denotes the end of the system number and the beginning of the pager's private or group address. Pressing this key enters an 'E' on the display. In our example, the display will now show: " 2E".

6) Enter the pager's private address. If a group address is desired in place of the private address, press the A key and enter the corresponding group address. In our example, if we enter pager number fifteen, the display will show: " 2E15". If instead we wanted group three, the display will show: " 2EA3".

7) Press the SEND key to send the page to the pager. If any mistakes were made entering the pager information, the display will show: "Error ". Causes of common mistakes are:

1) forgetting the * designator between the system and private addresses,

2) forgetting to enter a private or group address,

3) entering system, private or group addresses that are outside the valid range.

Clear the Error message by pressing the CLEAR key and re-enter the information as explained in steps one through six above.

8) The page may be resent by pressing the SEND key again. The system and private or group address shown in the display will be used again. To change the system number or the ID or group number, press the CLEAR key; the display will show: " 0". Enter the information as explained in steps one through six.

MOTOROLA
Americas Parts Division

R1151

EXPANDED

CODE SYNTHESIZER II

OPERATOR'S MANUAL

68P80310B03-B

10/13/94

4.0 R1151 Introduction

The R1151 is a memory expanded version of the R1150 *Code Synthesizer II*. The R1150 will only support those formats listed in Table 2.1-1, including the binary paging formats GSC, numeric POCSAG, alphanumeric POCSAG, NEC, and SGP. Any additional formats will ONLY be supported by the R1151. Descriptions of these formats and steps to use your R1151 for each format appear in the following pages.

All R1150 models may be upgraded to the R1151 model by installing the RLN4504 *R1150 Memory Upgrade* kit. This upgrade kit adds 16K bytes of EPROM (Erasable Programmable Read Only Memory), 8K bytes of RAM (Random Access Memory), and a second D/A (Digital to Analog) Converter. Installation instructions are included with the RLN4504 kit.

4.1 R1151 Power-Up

We recommend that the Power-Up steps and checks mentioned in section 1.2 be followed for the R1151. The power up self test and RAM check is one to two seconds longer for the R1151 than it is for the R1150 due to the increased RAM. Upon a successful self test, the R1151 display will read "1151" followed by the version of the installed firmware.

5.0 FLEX™

The FLEX™ format is a synchronous paging protocol that uses two level and four level frequency shift keying (FSK) modulation techniques. FLEX™ operates at four different baud rate/FSK level combinations: 1600 baud/2 level, 3200 baud/2 level, 1600 baud/4 level (which is equivalent to a 3200 baud transmission), and 3200 baud/4 level (which is equivalent to a 6400 baud transmission). The R1151 can operate at each of these baud rate/FSK level combinations according to the value stored in the Binary Paging Baud Rate Register. The increase in FSK levels from two to four introduces four logic levels: +1.0v, +0.333v, -0.333v, -1.0v. The addition of the two "intermediate" symbols, +0.333v and -0.333v, can adversely affect the pager's sensitivity when operating in 4 level FSK mode if the R1151's logic levels are not maintained within one percent (1%) of these standard values. Consequently, the R1151 has a calibration procedure that you can perform to guarantee your R1151 remains within specification. The calibration procedure is described in section 6.0; we recommend that you check the output level AT LEAST once a year. In fact, if you experience degraded sensitivity or any other strange behavior with your pager under test, first check that the D/A output levels are within specification.

NOTE: We recommend that you follow the calibration/output level check procedure in section 6.0 and periodically check the +1.0v and -1.0v levels, adjusting them if so required. FLEX™ pagers are extremely sensitive to logic levels when operating in the 4 level FSK mode; the sensitivity of these pagers will be reduced if the +/-1.0v levels are not maintained within specification.

5.1 Sending a FLEX™ Page

Since the FLEX™ format is a synchronous protocol, the time base of the pager under test and the R1151 time base must be synchronized.

Therefore, **BFORE** the first FLEX™ page is sent, the power of the pager under test **MUST** be recycled; that is, the pager must be turned off and on. After power up, the pager will realign itself with the R1151 time base during the first page. You can send subsequent pages without recycling the pager's power since at the end of each page the R1151 instructs the pager to go into asynchronous mode. The AR command mentioned below causes the pager to enter asynchronous mode. The R1151 digital output **MUST** be calibrated according to the procedure in section 6.0.

The R1151 has two modes for sending FLEX™ pages, single page mode and repeat page mode. When a single FLEX™ page is sent, the R1151 sends three (3) frames of information to the pager. Each frame is approximately 1.875 seconds in length; therefore, a single page will take 5.625 seconds. The first frame is an idle codeword frame; this allows the pager to synchronize to the R1151 time base. The second frame is the message frame. The third frame is a command for the pager to enter asynchronous mode. Figure 5.1-1 illustrates a single page.

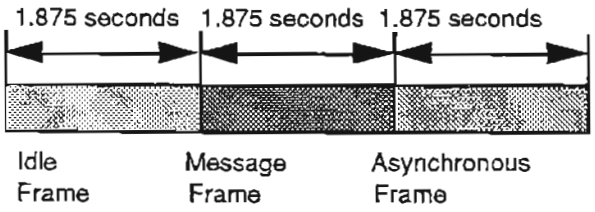


Figure 5.1-1

While the single page mode frames are being transmitted, the display will read "Phase x" where x is the phase of the pager under test.

IMPORTANT:

Do NOT remove the pager under test from the radiation test fixture while the R1151 display shows the phase. The pager may be removed only when the Capcode reappears in the display. Failure to follow this direction may result in the pager missing pages!

In repeat page mode, you specify the number of pages sent to the pager in Binary Paging Mode register 1. Each repeat page begins with an idle codeword frame, and an idle codeword frame appears between each message frame. The last frame sent in repeat page mode is the asynchronous command frame. The total number of frames sent in repeat page mode is Y * 2 + 1, where Y is the number entered in Binary Paging Mode register 1. The total time for Y pages is:

1.875 seconds *(Y * 2 + 1).

Figure 5.1-2 illustrates repeat page mode.

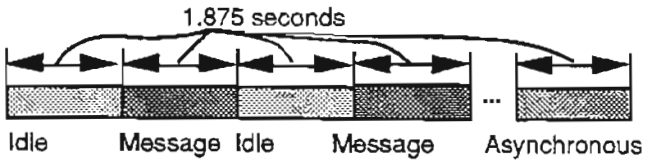


Figure 5.1-2

While these frames are being transmitted, "Phase x," where x is the phase of the pager under test, appears on the display during the transmission of the first message. Starting with the second message, the number or count of the actual page being sent is displayed .

IMPORTANT:

Do NOT remove the pager under test from the radiation test

fixture while the R1151 display shows the phase or the page count. The pager may be removed only when the Capcode reappears in the display. Failure to follow this direction may result in the pager missing pages!

5.2 Steps for Sending a FLEX™ Page

1) Recycle the pager's power; that is, turn the pager off and on.

2) Select the Digital Paging function with the up/down arrow keys.

3) Select the desired type of FLEX™ page by entering the appropriate number in register zero (R0).

Type of FLEX™ Page	R0
Tone Only	6
Numeric	7
AlphaNumeric	8

4) Store the baud rate/FSK combination in register four (R4).

Baud Rate	R4
1600 baud/ 2 level	0
3200 baud/ 2 level	1
1600 baud/ 4 level	2
3200 baud/ 4 level	3

5) If you want to send the pager a given number of continuous pages, enter this number in register one (R1). Note that the maximum number of continuous pages sent is 256. If you only want to send a single page, enter a 0 or a 1 in register R1. Note that the default or R1151 power up setting of register R1 is 0.

6) The pager's Capcode will include an alpha (A-Z) character. Enter the corresponding number from Table 5.2-1 intoregister seven (R7). These alpha characters define the rules for determining the phase of the pager under test.

IMPORTANT:

The R1151 only puts your pager's address in one phase as determined by the alpha character stored in register R7. If this number is not entered correctly, the pager will NOT get the page.

Alpha	R7	Alpha	R7
A	0	I	20
B	1	J	21
C	2	K	22
D	3	L	23
E	10	U	30
F	11	V	31
G	12	W	32
H	13	X	33
Y	40	Z	41

TABLE 5.2-1 ALPHA CHARACTERS

7) Enter the digits to the right of the alpha character in the pager's Capcode. The number of digits to the right of the alpha character ranges in length from one digit to nine digits. When entering a nine digit number, the most significant digit is scrolled left off the display. However, the R1151 is still able to read this digit, so make sure you enter it.

8) Press the SEND key. The R1151 will display the pager's programmed phase. Use this number to determine the correct message your pager should receive according Table 5.2-2 and Table 5.2-3. Tone only pagers will identify the source according to the phase; that is, phase 0 will be source 1, phase 1 will be source 2 and so forth. The transmission may be

aborted at any time by pressing the CLEAR key. Note that during the transmission all keys but the CLEAR key are locked out. In fact, the R1151 only checks for the CLEAR key after the message frame is sent. Therefore, you may have to press the CLEAR key for about two seconds before it is recognized.

6.0 Calibration

Most formats in the R1151 will use the RLN4504 D/A output. We recommend that you periodically check the D/A output levels and perform the calibration if required.

6.1 Output Specification

The RLN4504 D/A output levels must be maintained within the following range.

Output	Range
-1.0v	-0.990v to -1.01v
+1.0v	+0.990v to +1.01v

6.2 RLN4504 Output Check

Use the following procedure to check the D/A output levels of your R1151.

1) With your unit turned on, use the up/down arrow keys to get to the Digital Paging mode.

2) Connect a voltmeter to the digital output (see Figure 1.2-1). Set the voltmeter range to measure +/-1.0vdc to three (3) place decimal accuracy (+1.000vdc or -1.000vdc).

3) Store a 9 in register zero (R0) (See Section 2.3). The R1151 outputs -1.0vdc. The voltage must be within the following range:
-1.010vdc < output < -0.990vdc.

4) Store a 10 in register zero (R0) (See Section 2.3). The R1151 outputs +1.0vdc. The voltage must be within the following range:
+0.990vdc < output < +1.010vdc.

6.3 RLN4504 Calibration

Use the following procedure to calibrate the D/A output levels of your R1151.

1) Remove AC line cord from the R1151.

2) In an antistatic environment, loosen the two screws from the back panel (See Figure 1.2-2, #4). Slide the chassis out of the brown housing.

3) Remove the top shield carefully, so as not to disconnect the daughterboard, and set it down in a manner such that you can see the daughterboard circuits.

4) Reapply power and turn on unit.

5) Calibrate the -1.0 volt level first. Use the up/down arrow keys to get to the Digital Paging mode. Enter a 9 in register zero (R0) (See Section 2.3).

6) Connect a voltmeter to the digital output (See Figure 1.2-1).

7) With a flat blade screwdriver, adjust potentiometer R107 on the daughterboard until the voltmeter reads -1.0 vdc, +/- 0.01vdc.

8) Calibrate the +1.0 volt level next. Enter a 10 in register zero (R0).

9) Adjust potentiometer R109 on the daughterboard until the voltmeter reads +1.0 vdc, +/- 0.01vdc.

10) Remove power from the unit and reassemble, being careful not to pinch any cables.

NUMERIC PAGES

Digits Right of Alpha Character	Baud Rate/FSK (R4 contents)	Phase Displayed on R1151(Pager's phase) Phase0 Phase1 Phase2 Phase3 Pager Displayed Message			
1 - 2,009,087	1600/2 (R4 = 0)	[0]-01234567	[0]-01234567	[0]-01234567	[0]-01234567
	3200/2 (R4 = 1)	[0]-01234567	[0]-01234567	[1]-12345678	[1]-12345678
	1600/4 (R4 = 2)	[0]-01234567	[0]-01234567	[1]-12345678	[1]-12345678
	3200/4 (R4 = 3)	[0]-01234567	[1]-12345678	[2]-23456789	[3]-34567890
2,101,249 - 999,999,999	1600/2 (R4 = 0)	[0]-0123456U	[0]-0123456U	[0]-0123456U	[0]-0123456U
	3200/2 (R4 = 1)	[0]-0123456U	[0]-0123456U	[1]-1234567U	[1]-1234567U
	1600/4 (R4 = 2)	[0]-0123456U	[0]-0123456U	[1]-1234567U	[1]-1234567U
	3200/4 (R4 = 3)	[0]-0123456U	[1]-1234567U	[2]-2345678U	[3]-3456789U

TABLE 5.2-2 FLEX™ NUMERIC MESSAGES

ALPHA-NUMERIC PAGES

Digits Right of Alpha Char.	Baud Rate/FSK (R4 contents)	Phase Displayed on R1151 (Pager's Phase)	Pager Displayed Message
1 - 2,009,087	1600/2 (R4 = 0)	Phase0:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
		Phase1:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
		Phase2:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
		Phase3:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
	3200/2 (R4 = 1)	Phase0:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
		Phase1:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
		Phase2:	-> ALPHA 40 CHARS: PHASE 1(B), SHORT <-<
		Phase3:	-> ALPHA 40 CHARS: PHASE 1(B), SHORT <-<
	1600/4 (R4 = 2)	Phase0:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
		Phase1:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
		Phase2:	-> ALPHA 40 CHARS: PHASE 1(B), SHORT <-<
		Phase3:	-> ALPHA 40 CHARS: PHASE 1(B), SHORT <-<
	3200/4 (R4 = 3)	Phase0:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
		Phase1:	-> ALPHA 40 CHARS: PHASE 1(B), SHORT <-<
		Phase2:	>-> ALPHA 40 CHARS: PHASE 2(C), SHORT <-
		Phase3:	->-> ALPHA 40 CHARS: PHASE 3(D), SHORT <
2,101,249 - 999,999,999	1600/2 (R4 = 0)	Phase0:	> ALPHA 40 CHARS: PHASE 0(A), LONG <-<-<
		Phase1:	> ALPHA 40 CHARS: PHASE 0(A), LONG <-<-<
		Phase2:	> ALPHA 40 CHARS: PHASE 0(A), LONG <-<-<
		Phase3:	> ALPHA 40 CHARS: PHASE 0(A), LONG <-<-<
	3200/2 (R4 = 1)	Phase0:	> ALPHA 40 CHARS: PHASE 0(A), LONG <-<-<
		Phase1:	> ALPHA 40 CHARS: PHASE 0(A), LONG <-<-<
		Phase2:	-> ALPHA 40 CHARS: PHASE 1(B), LONG <-<-
		Phase3:	-> ALPHA 40 CHARS: PHASE 1(B), LONG <-<-
	1600/4 (R4 = 2)	Phase0:	> ALPHA 40 CHARS: PHASE 0(A), LONG <-<-<
		Phase1:	> ALPHA 40 CHARS: PHASE 0(A), LONG <-<-<
		Phase2:	-> ALPHA 40 CHARS: PHASE 1(B), LONG <-<-
		Phase3:	-> ALPHA 40 CHARS: PHASE 1(B), LONG <-<-
	3200/4 (R4 = 3)	Phase0:	> ALPHA 40 CHARS: PHASE 0(A), SHORT <-<-
		Phase1:	-> ALPHA 40 CHARS: PHASE 1(B), LONG <-<-
		Phase2:	>-> ALPHA 40 CHARS: PHASE 2(C), LONG <-<
		Phase3:	->-> ALPHA 40 CHARS: PHASE 3(D), LONG <-

TABLE 5.2-3 FLEX™ ALPHANUMERIC MESSAGES